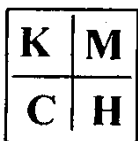


**EFFECTS OF EARLY STRENGTHENING ACTIVITIES  
AND FEEDBACK ON IMPROVING BALANCE IN  
CLIENTS WITH STROKE:  
A CASE STUDY**

**DISSERTATION SUBMITTED FOR  
MASTER OF OCCUPATIONAL THERAPY  
2009 – 2011**



**KMCH COLLEGE OF OCCUPATIONAL THERAPY**  
**The Tamilnadu Dr.M.G.R.Medical University, Chennai**

**Effects of early strengthening activities and feedback  
on improving balance in clients with stroke:  
A case study**

## **CERTIFICATE**

This is to certify that the research work entitled, “**EFFECTS OF EARLY STRENGTHENING ACTIVITIES AND FEEDBACK ON IMPROVING BALANCE IN CLIENTS WITH STROKE: A CASE STUDY**” was carried out by Mr. Edwin Vimalraj B (Reg. No. 41091030), KMCH College of Occupational Therapy, towards partial fulfillment of the requirements of Master of Occupational Therapy (advanced OT in Neurology) of the Tamilnadu Dr. M.G.R. Medical University, Chennai.

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## **ABSTRACT**

### **AIM**

To identify the effectiveness of early strengthening and feedback in improving balance in hemiplegics post stroke

### **METHODOLOGY**

Five clients affected with stroke with poor balance were taken for the study. They were screened using Berg balance Scale, Folstein test (Mini Mental Status Examination, MMSE), and Brunnstrom's stages. Clients who matched the inclusion criteria (BBS score < 40, MMSE score > 20 and Brunnstrom's stage of zero) were taken into the study. The clients were provided with the treatment using the biomechanical frame of reference with the aid of feedback techniques. After completion of treatment protocol, they underwent a post-test using Berg Balance Scale. The acquired data was analysed.

### **RESULTS**

All the five clients taken in the study shifted from a high fall risk to medium fall risk level. The client, who showed the highest change in balance score in the whole group is Client A, had a score change of 14, while Client B had a score of 12. Client C and E had a change score of 7. Client D did not show much improvement, with score of only 3.

### **CONCLUSION**

This study shows that there is a change in the balance grades among the clients with stroke when using the strengthening activities. Activities based on Biomechanical Frame of Reference coupled with components of feedback techniques works for improving balance in clients with stroke. Even with limited client numbers and limited time duration of the study, this response was elicitable. Thus, the study suggests that this intervention can be further dealt with in future researches and can be combined in future treatment protocols to work on clients with stroke.

## INTRODUCTION

A cerebro-vascular accident (CVA), also known as a stroke, is caused by a disruption of the blood supply to the brain, which results in anoxia and brain tissue death. Stroke is characterized by a sudden or gradual onset of neurological deficits. The location of the lesion, extent of the injury and mechanism by which the vascular injury occurred each play a role in the typical course and prognosis for recovery. Some individuals may experience small lacunar strokes from which they recover fully, while others may experience complete strokes from which the symptoms never fully subside. Ischemic strokes, which account for approximately 88% of strokes, are caused by vessel blockage secondary to arteriosclerotic or hypertensive stenosis. Hemorrhagic strokes, in which recovery is often less promising, result from rupture in an arteriosclerotic blood vessel.

Although recovery has traditionally been thought to peak within the first three months after stroke, with slower recovery for up to one year, new evidence indicates that recovery of function is possible for many years. The course of recovery is unpredictable; some individuals regain full function, and others regain very little. One of the common symptoms which we deal with postural control and balance.

Loss of trunk control is commonly observed in patients who have had a stroke. Impairment in trunk control may lead to the dysfunction in upper and lower limb control, increased risk of falls, potential for spinal deformity and contracture, impaired ability to interact with the environment, visual dysfunction secondary to resultant head/neck mal-alignment, symptoms of dysphagia secondary to proximal mal-alignment, and decreased independence in activities of daily living (ADL) (Era, 1997).

It is well known that, Occupational therapy effectively improves performance of ADLs / IADLs and role participation for individuals who have experienced stroke. Goal-specific teaching and practice of meaningful, client-chosen activities in a familiar context along with provision of necessary adaptations and training in the use of these adaptations has proved to be effective for improving occupational performance after stroke. Treatments that occupational therapists use to remediate impairments are generally beneficial, especially those that involve activity and/or occupation to bring about change.

Until few years back, the common understanding about the postural control was poor balance, visual deficits and problems in muscle power. In the recent past, there has been a

debate about unilateral neglect, and still over past few years, the perception of self and space have come to the light saying that it is also important.

Studies suggest that more than spasticity, weakness presents a more serious compromise to movement function in post stroke hemiplegia. They studied the functional and clinical phenomenon of weakness in hemiplegics. Based on this information, we can describe some unsolved problems and can indicate some likely aspects of development to increase our knowledge, regarding how resistance-training program can be included in effective stroke rehabilitation. (Patten, 2004)

Ryerson (2008) did a study to determine whether trunk position sense is impaired in people with post-stroke hemiparesis. 20 subjects with chronic stroke and 21 non-neurologically impaired subjects participated in the study. Trunk repositioning error during sitting forward flexion movements was assessed. Subjects with post stroke hemiparesis exhibit greater trunk repositioning error than age-matched controls. Trunk position sense retraining, emphasizing sagittal and transverse movements should be further investigated as a potential post-stroke intervention strategy to improve trunk balance and control.

A study was done to assess if recovering stroke patients with initially good sitting balance and those who develop good sitting balance during the rehabilitation have better Barthel Index based functional assessment outcomes than recovering stroke patients with poor sitting balance. The group of patients whose sitting balance improved had higher Barthel Index scores than the group whose sitting balance did not improve. Ongoing evaluation of sitting balance can be helpful in anticipating functional status at discharge in stroke patients undergoing comprehensive rehabilitation. (Sandin, 1990)

To function normally in daily life, an individual must have the ability to maintain and adopt various postures; react to external disturbances, and use automatic postural responses that precede voluntary movements. Following stroke, some of these activities generally become more difficult. Increased sway during quiet standing, uneven weight distribution with increased weight bearing on the unaffected limb, decreased weight-shifting ability in stance, and abnormalities in postural responses have documented. A major focus of rehabilitation programs is to improve balance and optimize function and mobility (Culham, 2000)

Quantitative assessment of balance problems allows better understanding of defective balance components. In addition, we can specifically plan to stimulate the defective component or other functioning sensory inputs to compensate the defective components of



balance. Observation from this preliminary study suggests that visual biofeedback training facilitates appropriate balance strategies and enables in achieving improved postural control. Functionally also, improvement in mobility and locomotion with confidence is achieved with improved postural control (Sharma, 2001).

Balance is required to become more proficient in self-care and independent in life tasks. Balance problem could be due to skeletal, muscular, or perceptual. Even though muscular component of balance have been dealt with in earlier studies (Patten, 2004), it is being dealt with in the later stages of Brunnstrom stages, after the client crosses the second stage (Pedretti). As Occupational Therapists', we require to make the clients more independent in Activities of Daily living and as soon as possible. This requires them to be able to get their sitting balance earlier in the treatment sessions. It is proven that both trunk performance in sitting position and balance in lying, sitting and standing posture if good after stroke, had predicted good functional ability and destination at discharge from inpatient rehabilitation. The Scores from the Postural Assessment Scale for Stroke patients showed slightly better prognostic value than scores from the Trunk Impairment Scale (Di Monaco, 2010).

Therefore, the investigator in the study has tried to attempt an early strengthening program of core muscles to see the effectiveness on balance in the post stroke clients within the first two weeks of onset of stroke.

## **AIMS & OBJECTIVES**

### **AIM:**

To identify the effectiveness of early strengthening and feedback in improving balance in hemiplegics post stroke

### **OBJECTIVES:**

- Evaluate the presence of problems in balance in clients with stroke
- Implement the interventions to the clients with stroke.
- Evaluate the interventions executed to the clients with stroke.

## RELATED LITERATURE

Among all the neurologic diseases, the stroke clearly ranks first in frequency and importance. A stroke, also known as a cerebro-vascular accident (CVA), is caused by a disruption of the blood supply to the brain, which results in anoxia and brain tissue death. A stroke is characterized by a sudden or gradual onset of neurological deficits. The primary feature that is of concern in stroke is loss of function of one side and loss of balance.

The father of medicine, Hippocrates, recognized stroke around 2,400 years ago. At that time it was called apoplexy, which in Greek means "struck down by violence". This was given due to that a person suddenly developed paralysis and change in well-being. Doctors back then had very little knowledge of the anatomy and function of the brain, the cause of stroke, or how to treat it.

It was not after the 1600s that Dr. Jacob Wepfer found that patients who had apoplexy also had bleeding in the brain. He discovered that a blockage in one of the brain's blood vessels could also cause apoplexy.

Medicine continued to swot the cause, symptoms, and treatment of apoplexy and, eventually, in 1928, apoplexy was divided into categories based on the cause of the blood vessel problem. Then there were the terms stroke or "cerebral vascular accident (CVA)."

It must be noted that, in the last two decades, new and extraordinary types of imaging technology have been introduced that allow the physician to make physiologic distinctions between normal, ischemic, and infarcted brain tissue. This biopathologic approach to stroke will likely guide the next generation of treatments and has already had a pronounced impact on the direction of research in the field. Salvageable brain tissue to be protected in the acute phase of stroke can be delineated by these methods. To identify this ischemic but not yet infarcted tissue virtually defines the goal of modern stroke treatment. Which of the sophisticated imaging techniques will contribute to improved clinical outcome is still to be determined, but certain ones, such as diffusion weighted imaging, have already proved invaluable in stroke work.

Despite these valuable advances in stroke neurology, three points should be made. First, we all have a role to play in the prevention of stroke by encouraging the reduction in

risk factors such as hypertension and the identification of signs of potential stroke, such as transient ischemic attacks, atrial fibrillation, and carotid artery stenosis. Second, careful bedside clinical evaluation integrated with the newer testing methods mentioned above still provide the most promising approach to this category of disease. Finally, the last decade or two have witnessed a departure from the methodical clinicopathologic studies that have been the foundation of our understanding of cerebrovascular disease. Increasingly, randomized studies involving several hundred and even thousands of patients and conducted simultaneously in dozens of institutions have come to dominate investigative activity in this field. These multicenter trials have yielded highly valuable information about the natural history of a variety of cerebrovascular disorders, both symptomatic and asymptomatic. However, this approach suffers from a number of inherent weaknesses, the most important of which is that the homogenized data derived from an aggregate of patients may not be applicable to a specific case at hand. Moreover, many large studies show only marginal differences between treated and control groups. Each of these multicenter studies will therefore be critically appraised at appropriate points in the ensuing discussion.

## **STROKE RISK FACTORS**

Some of the stroke risk factors are hereditary. Others are a functional in natural processes. And others result from a person's lifestyle. You cannot change few factors especially ones related to heredity or natural processes, but those that are resulting from lifestyle or environment can be modified with the assist of a healthcare professional.

### *Factors that cannot be changed*

- Age Heredity (family history) and race
- Sex (gender)
- Prior stroke, TIA or heart attack

### *Factors that can be changed, treated or controlled*

- |                                   |                                    |
|-----------------------------------|------------------------------------|
| • High blood pressure             | • Sickle cell disease              |
| • Cigarette smoking               | • High blood cholesterol           |
| • Diabetes mellitus               | • Poor diet                        |
| • Carotid or other artery disease | • Physical inactivity and obesitzz |
| • Atrial fibrillation             |                                    |

### *Rare risk factors*

- Geographic location
- Socioeconomic factors
- Alcohol abuse
- Drug abuse

Although recovery has traditionally been thought to peak within the first three months after stroke, with slower recovery for up to one year, new evidence indicates that recovery of function is possible for many years. The course of recovery is unpredictable; some individuals regain full function, and others regain very little. The primary symptoms of the stroke will be hemiplegia/paresis, functional impairment, aphasia, apraxia, dysarthria, visual-perceptual deficits, somatosensory deficits, balance & postural control, cognitive deficits, psychosocial deficits and incontinence.

Most of the aspects of a person's independency relies in the fact that the person will be able to maintain a posture for functional purpose or to use the limbs for ADL or in the fact that he / she will use it for further improve his / her skill. This ability to maintain the posture in a prescribed position is called balance.

### **BALANCE**

Balance is the ability to control the centre of mass over the base of support within the limits of stability; balance results in the maintenance of stability and equilibrium. A person's ability to maintain balance in any position depends on a complex integration of multiple systems.

### **BRIEF TRUNK ANATOMY**

The bony components of trunk anatomy include articulations and range of motion. The components are:

#### *Vertebral Column*

The vertebral column is made up of 26 vertebrae, which are classified as follows:

1. Cervical: 7
2. Thoracic: 12
3. Lumbar: 5
4. Sacral: 5 (fused into one bone—the sacrum)
5. Coccygeal: 4 (fused into one or two bones—the coccyx)

As a whole, the vertebral column from sacrum to skull is equivalent to a joint with three degrees of freedom in the directions of

- Flexion and extension,
- Right and left lateral flexion, and
- Axial rotation

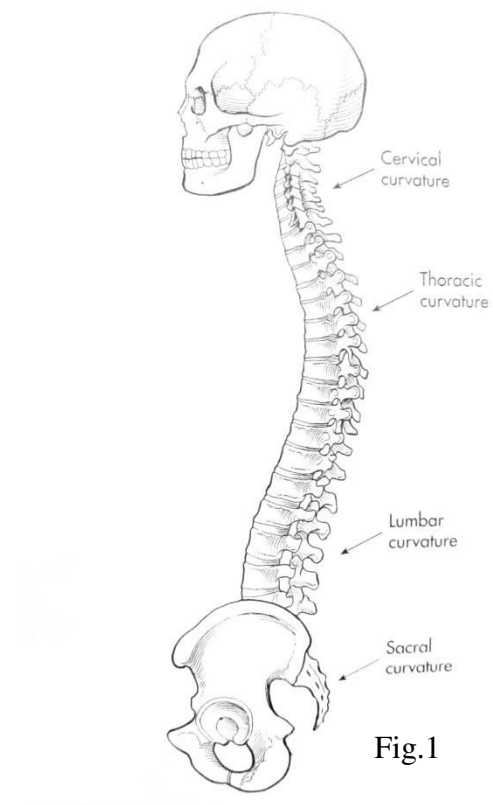


Fig.1

An understanding of spinal alignment is necessary for effective evaluation and treatment planning. Normal alignment of the vertebral column implies that the appropriate spinal curvatures are present.

### *Muscular System*

The general functions of the abdominal muscles are the following:

- Abdominal viscera support
- Respiration assistance
- Trunk control in the directions of flexion, lateral flexion, and rotation

Although these muscles are situated primarily on the anterior aspect of the trunk, they are also situated laterally and slightly posteriorly, forming a girdle around the abdomen. The abdominals consist of three groups of muscles

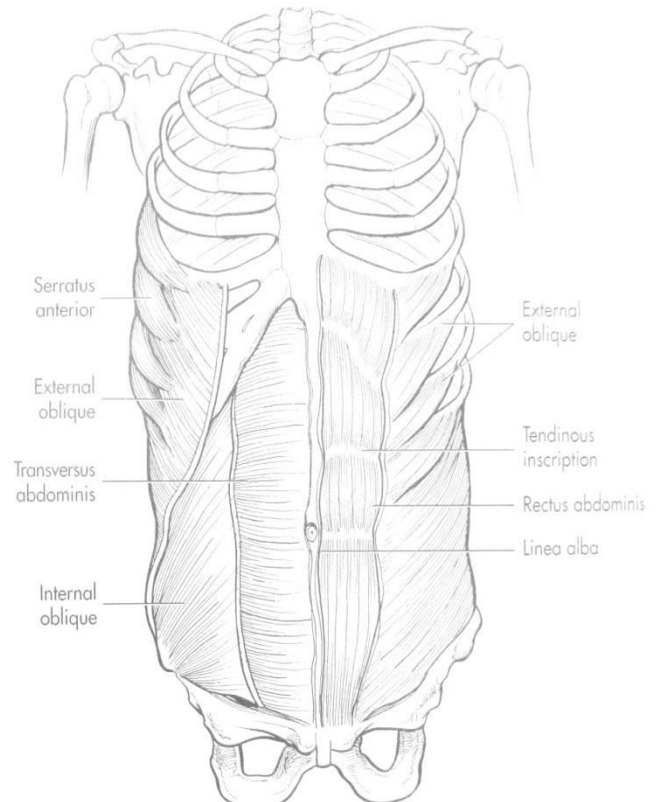


Fig.2

1. The rectus abdominus,
2. The obliques (internal and external),  
and
3. The transversus abdominus

### Posterior Trunk Muscles

This group of muscles includes

1. Quadratus lumborum,
2. The erector spinae group, and
3. Latissimus dorsi.

The actions of this group of muscles include trunk extension, lateral flexion, rotation of the trunk, and assistance with balancing the vertebral column.

### SENSORY ORGANIZATION

In other terms, balance is considered the interaction of reflexes and reactions, which are organized hierarchically, that result in the support of the body against gravity. In this, information from three sensory systems is utilized for maintaining balance and balance deficits are the result of eliminating higher central nervous system. Information from the visual, vestibular, and somato sensory systems are of critical importance.

The visual system provides information regarding vertical orientation and visual flow. Visual or optical flow information that describes movement of an image on the retina, is important input that aids in the detection of personal and environmental movement. Information provided by the visual system can be ambiguous and must be compared to other sensory information to determine accuracy. For example, a person sitting in a stationary car next to another stationary car at a red light may then receive optical flow information that indicates the other car is moving backward. This information alone is not adequate for determining which vehicle is moving; it only reveals that there is relative movement. The information must be compared to the other sensory information to determine which car has moved.

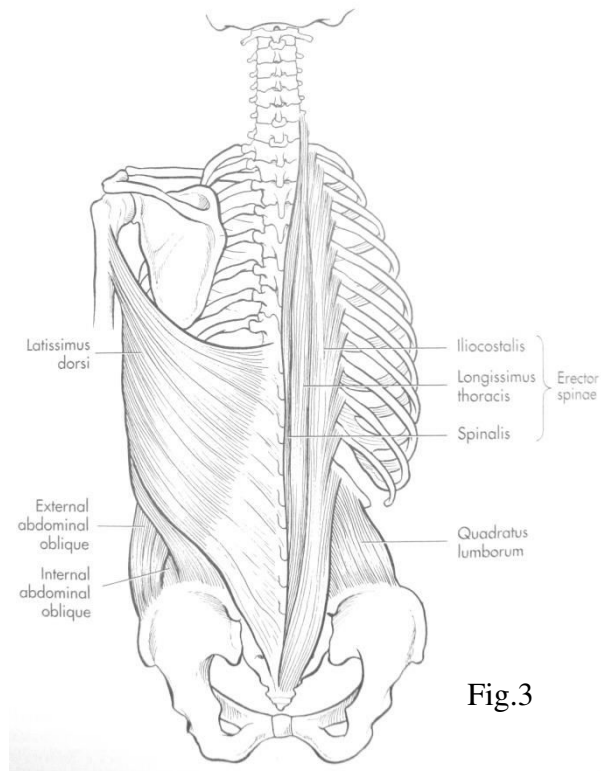


Fig.3

Somatosensory information is comprised of cutaneous and pressure receptors on the soles of the feet as well as muscle and joint receptors. It helps determine characteristics of and the relationship of the individual to the support surface. During most tasks, somatosensory information may be the most heavily relied on input in the adult population. Like visual input, somatosensory input can be ambiguous. For example, dorsiflexion at the ankle indicates that the body is anteriorly displaced over the base of support.

Information from the vestibular system helps determine head position and head motion in space relative to gravity. It generally plays a minor role in the balance control, unless somatosensory and visual systems are inaccurate or unavailable. It is the only sensory reference that is not ambiguous, because it depends on gravity, which is consistent in our environment.

## **IDENTIFYING THE PROBLEM**

Patients should be questioned about their perceived stability limits. Stability limits have been defined as the "boundaries of an area of space in which the body can maintain its position without changing the base of support." Patients' perceived stability limits may or may not be consistent with their actual limits. If patients' perceived limits of stability are greater than their actual limits, they are at risk for falls. If their perceived limits of stability are less than their actual limits, they may be reluctant to attempt tasks with progressively greater demands on their postural system (e.g., lower extremity dressing without assistive devices, picking up objects from the floor without a reacher).

Other deficits include body neglect, somatoagnosia, and impaired right/left discrimination. Spatial relations deficits including spatial neglect, depth perception, and spatial relations disorders may also have an impact on patients' perceived stability limits, (gaining and regaining midline orientation position in space).

Other components of the subjective interview include determining patients' insights into their trunk mal-alignments and their ability to perceive and assume midline positions. The therapist's goal in this interview is to gain insight into the patients' ability to make accurate observations about their postural dysfunction. This is difficult for many patients because trunk control does not occur at a conscious level in the majority of daily tasks.

The therapist must remember that observed posture may be secondary to other impairments. This posture may be a result of one of or a combination of the following:



- Weakness or lack of activity in the trunk extensors, especially in the lower back
- Fixed contracture of the hamstrings and/or thoracic spine
- Abdominal weakness: The mentioned posture changes the centre of gravity and decreases the potential to fall backwards. The abdominals are primarily responsible for preventing backward sway, therefore assuming a flexed posture reduces the chance of having to activate the abdominals to prevent falls.

Another example of a commonly observed misalignment is trunk shortening on the side affected by the stroke. This posture may be assumed for several reasons:

- Inactive shoulder elevators on the side affected by the stroke that let the shoulder depress
- Increased muscle activity of the scapula depressors that pull the shoulder down on the affected side
- Perceptual dysfunction resulting in an inability to find midline—bearing most weight on the stronger side than the affected side
- Increased muscle activity or shortening of the affected lateral flexors resulting in a shortening response
- Fear of shifting weight to the affected side—majority of weight on stronger side resulting in shortening of the affected side

Following the observation of the patient in a static posture, the occupational therapist must observe trunk responses during functional activities. The two most effective methods of making these observations are observing patients during self-care and controlled reach pattern activities. During functional reach patterns, trunk responses are required to

- Provide proximal stability for distal function,
- Enhance the ability to interact with the environment by increasing reaching distance (i.e., extend the arm span with an appropriate trunk response), and
- Prevent falls.

The therapist's goals while observing the patient perform functional reach patterns are the following:

- Ensure that trunk and upper extremity patterns are coordinated to result in successful task completion.
- Note any fall potential.
- Note asymmetries during reaching.
- Objectively evaluate the perceived and actual stability limits of the patient.
- Note in which directions the patient is or is not able to reach beyond the arm span.
- Note factors such as trunk stiffness and decreased ROM.

## **BRUNNSTROM'S STAGES OF MOTOR RECOVERY**

Brunnstrom, a physical therapist, was particularly concerned with the problems of patients with hemiplegia. The basic premises of this approach are: In normal persons, spinal cord and brain stem reflexes become modified during development and their components rearranged into purposeful movement by the influence of higher centres. Since reflexes represent normal stages of development, they can be used when the CNS has reverted to an earlier developmental stage as in hemiplegia.

In addition, she believed that no reasonable training method should be left untried. Moreover, the sub-cortical motion synergy, which can be elicited on a reflex basis, may serve as a wedge by which the limited willed movement may be learned. Therefore:

1. Reflexes should be used to elicit movement when none exists (normal developmental sequence).
2. Proprioceptive and exteroceptive stimuli can be used therapeutically to evoke desired motion or tonal changes.

### ***Evaluation:***

1. Tonic reflexes
  - a. Influence of reflexes:
  - b. Symmetric Tonic Neck Reflex (STNR):
  - c. Asymmetric Tonic Neck Reflex (ATNR):

- d. Tonic Labyrinthine Reflex (TLR):
  - e. Tonic Lumbar Reflex:
  - f. Tonic Thumb Reflex:
2. Associated reactions: Associated reactions are automatic responses of the involved limb resulting from action occurring in some other part of the body, either by voluntary or reflex stimulation.
3. Stages of motor recovery:

Brunnstrom classified stages of recovery into six stages:

*Stage 1:* The patient is completely flaccid, no voluntary movement, and patient is confined to bed.

*Stage 2:* Basic limb synergy develops, no voluntary movement, can be done as spasticity appears but is not marked.

*Stage 3:* Basic limb synergy develops voluntarily and is marked, spasticity is marked. (This is the stage of maximal spasticity).

*Stage 4:* Spasticity begins to decrease, four movement combinations deviate from basic limb synergies and become available, which are placing the hand behind the body, alternative pronation – supination with the elbow at 90° flexion and elevation of the arm to a forward horizontal position).

*Stage 5:* There is relative independence of the basic limb synergies. Spasticity is waning, and movements can be performed as arm rising to a side horizontal position, alternative pronation – supination with the elbow extended and bringing hand over the head.

*Stage 6:* There are isolated joint movements.

## **OCCUPATIONAL THERAPY AND THE EVIDENCE**

Occupational therapy effectively improves performance of ADLs/IADLs and role participation for individuals who have experienced stroke. Goal-specific teaching and practice of meaningful, client-chosen activities in a familiar context along with provision of necessary adaptations and training in the use of these adaptations has proved to be effective for improving occupational performance after stroke. Treatments that occupational therapists

use to remediate impairments are generally beneficial, especially those that involve activity and/or occupation to bring about change.

## **TREATMENT FOR BALANCE**

Treatment for balance in stroke varies from basic dynamic or static balance activities to muscle strengthening to the latest visual vertical perception. Even though many of the clients when given basic balance activities they improve, the specialised treatment of individual problem should be sorted. To attain this, an assessment is done to understand the part or function that is affected.

## **THE BIOMECHANICAL FRAME OF REFERENCE**

The biomechanical frame of reference was identified as the most frequently used in practice, and rehabilitation frames is among the top five. The biomechanical frame of reference applies the principles of physics to human movement and posture with respect to the forces of gravity. Many health professionals use biomechanical principles in their practice. Occupational therapists are unique in applying them to clients' engagement in the tasks of everyday life. In OT, the principles of movement, including range of motion (ROM), strength, endurance, ergonomics, and the effects or avoidance of pain, must be considered within the context of occupation. Occupational therapists are unique in applying them to clients' engagement in the tasks of everyday life. In OT, the principles of movement, including range of motion (ROM), strength, endurance, ergonomics, and the effects or avoidance of pain, must be considered within the context of occupation. The technique used under Biomechanical frame of Reference is strengthening.

### ***Modes of Exercise***

*Isotonic:* alternating eccentric and concentric muscle activation that moves a body part through an arc of motion against the resistance

*Isokinetic:* exercise that involves a specialized equipment and which provides "accommodating resistance", so that the joint moves at a constant angular velocity

*Isometric:* muscle action which is performed against resistance at any point in a joint's range of motion, for periods of 5-10 seconds, and which produces no joint movement

*Plyometric*: exercise which requires eccentric activation of the muscles against a prescribed resistance, followed by a brief period of amortization, followed by concentric activation

### ***Measuring exercise intensity***

Repetition maximum (RM): "maximal number of times a load can be lifted before fatigue using good form and technique (ACSM, 1998)."

A "1RM" signifies a maximum resistance that the person can move in one repetition of an exercise. As per guidelines for the trunk, crunches or rising from the supine level is considered as a load. The ACSM recommends that the client exercise at an intensity of 8 to 12 RM. (moon.ouhsc.edu)

### **FEEDBACK**

Feedback is Intrinsic or extrinsic information that patients receive while learning to perform a new skill or strategy.

### ***Therapeutic use of feedback***

Feedback can also enhance or interfere with learning. Occupational Therapists understand the functions of feedback and deliberately select the types and schedules of feedback in designing the patients' learning experience.

### ***Functions of feedback***

Feedback regarding performance has several functions. It has a temporary motivating or energising effect and a guidance defect that informs the subject how to correct an error on the next trial. However, feedback can permanently impair motor learning if provided beyond the point that the person has a rough idea of the desired motion.

### ***Types of feedback***

To help patients learn and sustain skills and strategies, therapists initially provide extrinsic feedback on performance but ultimately facilitate the development of intrinsic feedback.

1. *Extrinsic feedback: Knowledge of results and knowledge of performance*

Therapists typically provide feedback about performance in verbal format. Extrinsic or external information presented after task is complete is called knowledge of results. This feedback allows subject to alter or alert their responses or behaviours on subsequent trials. A second type of feedback, knowledge of performance is related to qualitative description of a performance. This info directs patients' attention not to outcome but to components of movement that they need to change or attend. This type of feedback duplicates information patients already have available through intrinsic feedback; but on which they may not be focusing.

Other external information provided to patients during practice falls into the category of encouragement. It is important that patient and therapist not confuse encouragement with feedback especially if the later is not true, as incorrect feedback is highly detrimental to learning.

## *2. Intrinsic feedback*

IF or internal feedback is information that patients receive through their own senses. While this information is readily available to patients, they may need cuing to focus on the most important components of a skill or strategy, such as learning to use vision when moving an anaesthetic limb. Intervention that incorporates self-monitoring and self-estimation (task difficulty, completion time, accuracy score, amount of cuing or assistance needed) enables patients to create mechanisms for self-generated feedback, lessening dependence on therapists for successful performance.

## ***Feedback schedules***

The frequency and content of feedback are critical to the learning process and must be considered when the teaching situation is planned.

### *1. Immediate and summary feedback*

The frequency and rate at which the feedback is given can profoundly influence the acquisition and retention of task specific skills and strategies. Immediate feedback provided after each trial was completed or also referred to as constant feedback. Summary feedback provided after a number of trials are completed. In a study done by Lavery (1962), they found out that in acquisition phase both immediate and summary feedback given tighter helped well

than summary feedback alone. However, when tested on retention summary feedback alone helped well.

## *2. Faded feedback*

Therapists are often concerned about providing only summary feedback after a series of trials will not understand the tasks that are complex or new. Winstein and Schmidt (1990) evaluated the effectiveness of fading of the feedback. They found a slight advantage for the group with summary feedback in the acquisition phase, but there were significant difference during the retention phase, which is the true test of learning. The group that received faded feedback performed significantly better than immediate feedback on the retention trials. These finding point out the irony that factors that degrade performance during acquisition may improve learning.

## *3. Bandwidth feedback*

With Bandwidth feedback, an acceptable range of performance is defined and the subject receives feedback only when performance is outside the range. As the subject's performance improves, feedback is provided less frequently.

### *Techniques used for feedback:*

- Visual cues
- Verbal cues / Prompting
- Guiding

### *Pointers for Remediation:*

- Cognitive change depends on one's ability to learn & generalize.
- Response to cues for doing tasks & guidance strategies determine type of assistance needed for learning.
- Therapeutic use of self assists client in dealing with barriers to awareness.
- Self-observation may be assessed with the use of daily logs or journals.

## CAREGIVER CONCERNS

Caregiver burden is quite common after stroke, and high levels of burden are often related to deterioration of the caregiver's own health status, social life, and well-being. It was also concluded from low emotional mental scores on the SF-36 that informal caregivers are often under considerable strain. Furthermore, caregiver depression can worsen the depression of an individual who has had a stroke and may predict poor response to rehabilitation. Isolation from people other than the ones they are caring for is also a major concern for caregivers. It is imperative that caregivers be educated about taking care of themselves, including their physical, emotional, mental, spiritual, interpersonal, and financial health.

The following recommendations for informal caregivers have been adapted from the American Stroke Association (2005b):

1. Set goals and limits: Think realistically about what you can and cannot do.
2. Be organized: Have a “job description” in which you define what you and the one you are caring for need (i.e. assistance with housekeeping, shopping).
3. Recognize your own limits: Realize when you need a break and take time for yourself.
4. Involve others: Involve other family members and friends in the care giving experience.

As occupational therapists, we can utilize these recommendations to educate and assist caregivers with regard to their role in caring for the individual who has had a stroke.



## **REVIEW OF LITERATURE**

When it comes to the treatment of stroke and discussing about the balance, the first thing that is being evaluated and treated is the muscle strength and general balance activities. When we go deeper into research, we can find out, even with the problems in strength, there are few other components that are being used for balance. One of the primary things that are recently found is Visual vertical perception. Where conventional therapy have been given for years and proven effective, few studies have been done to find out the difference it makes in the earlier stages of therapy.

In an article published by Jiang et.al. (2010), they used myographic signals to find about the relationship between Maximum Isometric Voluntary Contraction (MIVC) and balance. They stated that due to the decrease in the muscle power of the clients with stroke, which is evident in the study, and due to increase in spasticity of few intervening muscles, that client should be given strengthening not only to ipsilateral side but also to the contra lateral side. Wen Jiang proved that the strength of bilateral thigh muscles actually decreases in stroke patients. But the spasticity of thigh extensor still exists. in addition to reducing the spasticity of the hemiplegic limb extensor, the rehabilitation should also be focused upon bilateral thigh muscles, particularly ipsilateral strength training to improve the knee joint stability and improve the balance function

Lubetzky – Vilnai (2010) in the review done on multiple studies on twenty-two published studies on stroke as a leading cause for long-term disability, and the impaired balance after stroke is always strongly associated with future function and recovery. Until recent past, there has been limited evidence that support the use of balance training to improve balance performance. Based on the evidence provided by this review, we provide recommendations for exercise prescription in balance programs.

Sitting unsupported requires postural stability of the trunk, which is also necessary for almost all activities in daily living, however there is still a lack of research dealing with the perseverance of trunk impairment after stroke using quantitative methodologies. Thus, a study was done to investigate unsupported sitting in individuals with chronic stroke, by analyzing centre of pressure (COP) signals from a force platform. Clients were made to sit in a chair and the trials consisted of closing of eyes, staring at a target, and COP feedback. This resulted in identifying that the controls had lesser sway area and stroke group had larger

displacements in all conditions. Perlmutter stated that data suggest that trunk control that was necessary for unsupported sitting is impaired well into the chronic stage of stroke onset. additional investigations of sitting should be conducted which could give better understanding of balance deficits under conditions localized to the trunk musculature.

Garland in his study in 2009 stated that residual sensorimotor deficits affect negatively on balance and quality of life. It was also stated that that purpose of this review was to provide an overview of the impairments in motor control following stroke and the impact of those impairments have on muscle activation patterns during the postural control in stroke. Motor control impairments that follow stroke result in slow force production, which is weak and lacking in precision that makes it difficult to produce a fast rate of force development, with sufficient magnitude that will be effective for postural responses. Postural perturbations even if requiring feedback or feedforward responses, there will be impairment to timing, magnitude and sequencing of muscle activation after stroke. The impairment in muscle activation depends on the extent of the motor control impairments and the strategies used by the clients following stroke to compensate for the impairments. The central nervous system may use a variety of mechanisms that improve the muscle activation patterns that is needed for the recovery of postural responses that follow stroke.

Ng (2010) examined the contribution of balance ability, muscle strength, and exercise endurance in performance in the timed-sit-to-stand test among stroke subjects. He did a cross sectional study which contained 68 clients and as the first study documenting the importance of balance ability, and not just muscle strength and exercise endurance, as an important determinant.

Problems in balance in clients after stroke can be caused by many different impairments in the physiological systems which might involve in postural control, which might include sensory afferents, biomechanical constraints, movement strategies, cognitive processing, and perception of verticality. Impairments in balance must be appropriately addressed. De Oliveira (2008) states that the most common abnormalities is balance in stroke patients.

Tung (2010) did a randomised control trial in 32 clients with stroke to find out the effectiveness of sit to stand training in clients with stroke. He established that in addition to general therapy session when given a training of sit to stand to improve strength, there was a significant difference in the directional control in the clients. He concluded that just 15

minutes of sit to stand would change the way the clients are reacting to balance in real life situation. Additional sit-to-stand training should be encouraged because the effect it has on dynamic balance and extensor muscles strength in subjects with stroke is good.

A systematic review was done to establish whether bilateral standing with visual feedback therapy improves postural control compared to conventional therapy. Moreover, to evaluate the generalization of the effects of visual feedback therapy, on gait and gait-related activities. Van Peppen (2006) stated that the additional value of visual feedback therapy given in bilateral standing compared with conventional therapy shows no, statistically significant, effects on symmetry of weight distribution amidst paretic and non-paretic leg, postural sway in bilateral standing, gait and gait-related activities. He also stated that Visual feedback therapy need not be favoured over conventional therapy. The question still remains as to how much of asymmetry exactly in weight distribution while standing is related to balance control in patients with stroke.

Study was done to, compare the difference in the centre of pressure measures while bending forwards and reaching, on postural actions between normal and clients with stroke and examine the effects of the task demands on the centre of pressure scores in both the groups. Chern (2010) stated that all variables except centre of pressure showed a significant group differences. The difference in postural actions between groups depends on task demands. Small centre of pressure displacement with fast centre of pressure velocity characterize a decreased adaptive postural actions. The amount of centre of pressure shift and centre of pressure velocity are also dependent on task demands for both the groups.

Oliveira (2008) stated that balance problems in hemiparetic patients after stroke can be caused by different impairments in the physiological systems involved in postural control, including sensory afferents, movement strategies, biomechanical constraints, cognitive processing, and perception of verticality and balance impairments and disabilities must be appropriately addressed. It was also stated in the article that they reviewed the most common balance abnormalities in hemiparetic patients with stroke and the main tools used to diagnose them. In the result of the study, they came up with many scales for the use of therapist in balance assessment and training. They were Berg Balance Scale (BBS), Timed Get Up & Go Test (TUG), Tinetti Balance Test (TBT), Functional Reach Test (FR), Balance Subscale of Fugl - Meyer Test (FM-B), Postural Assessment Scale for Stroke Patients (PASS), Dynamic Gait Index (DGI), Multi-Directional Reach Test (MDRT), and Activities-Specific Balance

Confidence (ABC) Scale. In conclusion, they stated that the balance is a complex motor skill that depends on interactions between multiple sensori-motor processes, and environmental, and functional contexts. In addition, Stroke can affect different functions independently, or in combination, causing heterogeneous neurological impairments and compensatory strategies. Because of such diversity, the individualized rehabilitation is likely to be benefited from precise assessment of each patient's impairments in motor, sensory, and cognitive aspects of postural control, as well as its functional implications. Different tools for balance assessment have to be validated and should be chosen according to individual characteristics of clients with stroke. Even though laboratory measurements are not widely available, they can provide precise information and should be combined with the clinical evaluation whenever possible to enhance comprehension of the postural impairments and disabilities in hemiparetic clients.

Research studies indicate that the sitting balance ability is a substantial predictor of functional recovery after stroke. There are no standard sitting balance assessments, and the balance measures that are commonly used, do not isolate sitting balance abilities. Gorman constructed The Function In Sitting Test (FIST) after reviewing measures and interviewing therapists. A scoring scale was designed, and pilot tested. Studies of intra- or inter rater reliability and validity including applications to patient populations with other conditions with dysfunction in sitting balance can be done.

Onigbinde, in 2009 stated in a research conducted with 17 stroke survivors rehabilitation was wobble board exercise were given. Statistics showed that there were significant difference in both static and dynamic balance. It can be concluded that wobble board exercise can be used to improve both static (eye closed) and dynamic balance.

Ryerson (2008) did a study to determine whether trunk position sense is impaired in people with post-stroke hemiparesis. Twenty subjects with chronic stroke and 21 non-neurologically impaired subjects participated in the study. Trunk repositioning error during sitting forward flexion movements was assessed. Subjects with poststroke hemiparesis exhibit greater trunk repositioning error than age-matched controls. Trunk position sense retraining, emphasizing sagittal and transverse movements, should be further investigated as a potential post-stroke intervention strategy to improve trunk balance and control

Nonnekkes, in 2010, stated that the ability to make adjustments in steps while walking is often impaired following a stroke, but the deficits in basic sensorimotor control that is responsible have not been established. They used ten stroke and 10 age-matched control

patients who stepped onto an illuminated rectangle. In 40% of cases there was a mid-step adjustment. Whatever the support condition stroke patients produced short-latency in foot trajectory adjustments that is compatible with a fast-acting visuomotor process. Still, the latency was significantly shorter for the ipsi-lesional leg than the contralesional leg and longer than for controls.

Slaboda compared the occurrence of visual field independence or dependence in healthy subjects with that of clients who are post-stroke using the Rod and Frame Test, and determined there is increased visual dependence is reflected in the client's postural responses when wrapped up in a moving visual environment. Center-of-mass (COM) of the body was then calculated for clients in the dark and when immersed in virtual environment to examine their postural responses. Balance of the clients did not differ from healthy subjects when standing in the dark, which suggest they were not dependent on the presence of vision, but more displacements were noted in the clients when immersed in a visual scene that was moving.

Bohannon (1986) conducted a retrospective audit of physical therapy evaluations to determine the incidence of sitting imbalance and the relationship to the side of weakness in clients with hemiparesis. A review of the records of 105 clients was done, and it revealed that the left side was affected in 52 clients and the right side in 53 clients. The clients with left hemiparesis are more likely to have difficulty with independent sitting, than clients with right hemiparesis, which may affect their progress in rehabilitation.

Era (1997) studied about the postural balance in relation to self-reported functional ability and general physical activities in elderly men and women. A random sample of 448 men and 556 women were taken for the study. The results suggested that good balance is one of the prerequisites of mobility and ADL. Even though the results were similar, there were some differences between men and women in this group.

[Chien](#) (2007) did a study to develop a Short Form of Postural Assessment Scale for Stroke patients (SFPASS) with sound psychometric properties. It consisted of 2 parts, they were developing the SFPASS and cross-validation and cross-validation of the best SFPASS using another independent sample of 179 people with stroke. As 1<sup>st</sup> part, the authors reduced the number of test items that constitute the PASS by more than half and simplified the scoring system. Then compared them with the Barthel activities of daily living index and the Fugl-Meyer motor test. The results provide strong evidence that 5-item PASS-3L has sound

psychometric properties in people with stroke. The 5-item PASS-3L is considered simple and fast to administer, and thus recommended. Table 4 shows the correlation between Berg Balance Scale and SFPASS scores. For balance, the score of Berg Balance Scale (BBS) is compared with the scores obtained by the clients in the Short Form Postural Assessment Scale for Stroke (SFPASS).

Hyndman (2006) did a study to explore the differences in cognitive motor interference between the people with stroke and the control group when performing functional tasks and to compare the dual task performance. The study consisted of 36 clients for 3 dimensional movement analysis in conjunction with cognitive activity. Clients with stroke and the controls employed similar strategies during simultaneous performance of simple functional task and silent cognitive tasks and maintained postural stability; the only change came in increased walk time and decreased cognitive recall, which were greater for people with stroke.

Bour (2010) stated that Cognitive deficits are very commonly observed in stroke patients. Neuropsychological testing is very time consuming and not easy to administer after hospital discharge. The Mini-Mental State Examination (MMSE) (Folstein test) is the test most widely applied to screen for cognitive deficits. The results indicate that the MMSE has modest qualities in screening for mild cognitive disturbances, and is adequate in screening for moderate cognitive deficits in stroke patients. Poor performance on the MMSE will be a predictive for cognitive impairment in the long term.

Tanaka (2010) did a study to test the predictive validity of a new scale, the Revised Version of the Ability for Basic Movement Scale (ABMS II). 71 patients after stroke participated in this study. In addition to the ABMS II score, limb paresis was measured by the Brunnstrom stage and functional ability by the Barthel Index. This study provided evidence for the predictive value (88.9%) of ABMS II with regard to functional ability in patients after stroke.

Frykberg (2007) study explored the correlation between clinical assessment and force plate measurement of postural control after stroke, when selected balance tasks were performed under similar spatial and temporal conditions. The inter – rater agreement was also examined for the assessment of weight distribution during quiet stance in subjects with stroke. Clinical assessment of postural control, in 20 subjects with stroke, were done using Berg Balance Scale, video recording (for rating of weight distribution), and force plate

measurement with the Vifor – system. As a result, clinical assessment of postural control and weight distribution showed only moderate correlation with force plate measurement when the assessments were performed under similar conditions. This data suggested that the reliability of observational postural analysis needed to be improved.

Chen (2002) studied the delayed effects of balance training program on hemiplegic stroke patients. They used a total of 41 ambulatory hemiplegic stroke and randomly assigned them into two groups, the control group and trained group. Visual feedback balance training with SMART Balance Master was used in trained group. Brunnstrom staging of the affected limb scores and Functional Independent Measure (FIM) scores of each patient were recorded. Quantitative balance function was evaluated using the SMART Balance Master. Significant improvements, were found, in dynamic balance function measurements, for patients in the trained group. The self-care and sphincter control also improved for patients in the trained group. On the other hand, there was no significant differences that were found in static balance functions between the trained group and control group at 6 months of follow up. The locomotion and mobility scoring of FIM also revealed that there are no differences between the groups. The results showed that balance training was truly beneficial for patients after hemiplegic stroke.

Visual feedback related to weight distribution and centre – of – pressure positioning has been shown to be effective in increasing stance symmetry following stroke, although not clear if functional balance ability also improves. This study compared the relative effectiveness of the visual feedback training of centre – of – gravity (CoG) positioning with conventional therapy following acute stroke. Forty – six clients participated this study. One group received regular therapy and second group received regular therapy and also received information about their CoG position as they shifted their weight during various activities. All groups demonstrated marked improvement over time for all the measures of balance ability, with the greatest improvements occurring in the period from baseline to the discharge. No between – group differences were identified. In conclusion, visual feedback or conventional balance training in addition to regular therapy minimal benefits when offered in the early stages of rehabilitation following stroke. (Walker, 2000)

To function normally in daily life, an individual must have the ability to maintain and adopt various postures; react to external disturbances, and use automatic postural responses that precede voluntary movements. Following stroke, some of these activities generally

become more difficult. Increased sway during quiet standing, uneven weight distribution with increased weight bearing on the unaffected limb, decreased weight-shifting ability in stance, and abnormalities in postural responses have documented. A major focus of rehabilitation programs is to improve balance and optimize function and mobility (Culham, 2000)

Quantitative assessment of balance problems allows better understanding of defective balance components. In addition, we can specifically plan to stimulate the defective component or other functioning sensory inputs to compensate the defective components of balance. Observation from this preliminary study suggests that visual biofeedback training facilitates appropriate balance strategies and enables in achieving improved postural control. Functionally also, improvement in mobility and locomotion with confidence is achieved with improved postural control (Sharma, 2001).



## CONCEPTUAL FRAME OF REFERENCE

Perlmutter stated that sitting unsupported requires postural stability of the trunk, which is also necessary for almost all activities in daily living; however, there is still a lack of research dealing with the perseverance of trunk impairment after stroke using quantitative methodologies. Thus, a study was done to investigate unsupported sitting in individuals with chronic stroke, by analyzing centre of pressure (COP) signals from a force platform. Clients were made to sit in a chair and the trials consisted of closing of eyes, staring at a target, and COP feedback. This resulted in identifying that the controls had lesser sway area and stroke group had larger displacements in all conditions. Perlmutter stated that data suggest that trunk control that was necessary for unsupported sitting is impaired well into the chronic stage of stroke onset. Additional investigations of sitting should be conducted which could give better understanding of balance deficits under conditions localized to the trunk musculature. (Perlmutter)

The occurrence of visual field independence or dependence in healthy subjects with that of clients who are post-stroke using the Rod and Frame Test, and determined there is increased visual dependence is reflected in the client's postural responses when wrapped up in a moving visual environment, was compared by Slaboda. Centre-of-mass (COM) of the body was then calculated for clients in the dark and when immersed in virtual environment to examine their postural responses. Balance of the clients did not differ from healthy subjects when standing in the dark, which suggest they were not dependent on the presence of vision, but more displacements were noted in the clients when immersed in a visual scene that was moving.

These above said studies stated that there are problems in balance more than typical body mechanics, it pertains to a multi contextual approach. When it come to Occupational Therapists', the majority of them choose to work in conventional manner. This puts a hinder in new learning and widening of horizons. The latest works state that balance is not purely due to physical issues but also due to perceptual components. They also stated that these issues should also be tackled.

All the researches done with the balance, are done in the later stages once the voluntary control improves. This led to this research to be conducted to find out the effectiveness of early training on balance and its effectiveness compared.

The clients were chosen on the basis of the criteria. The clients were given training to improve balance, using activities based on biomechanical principle and feedback techniques.

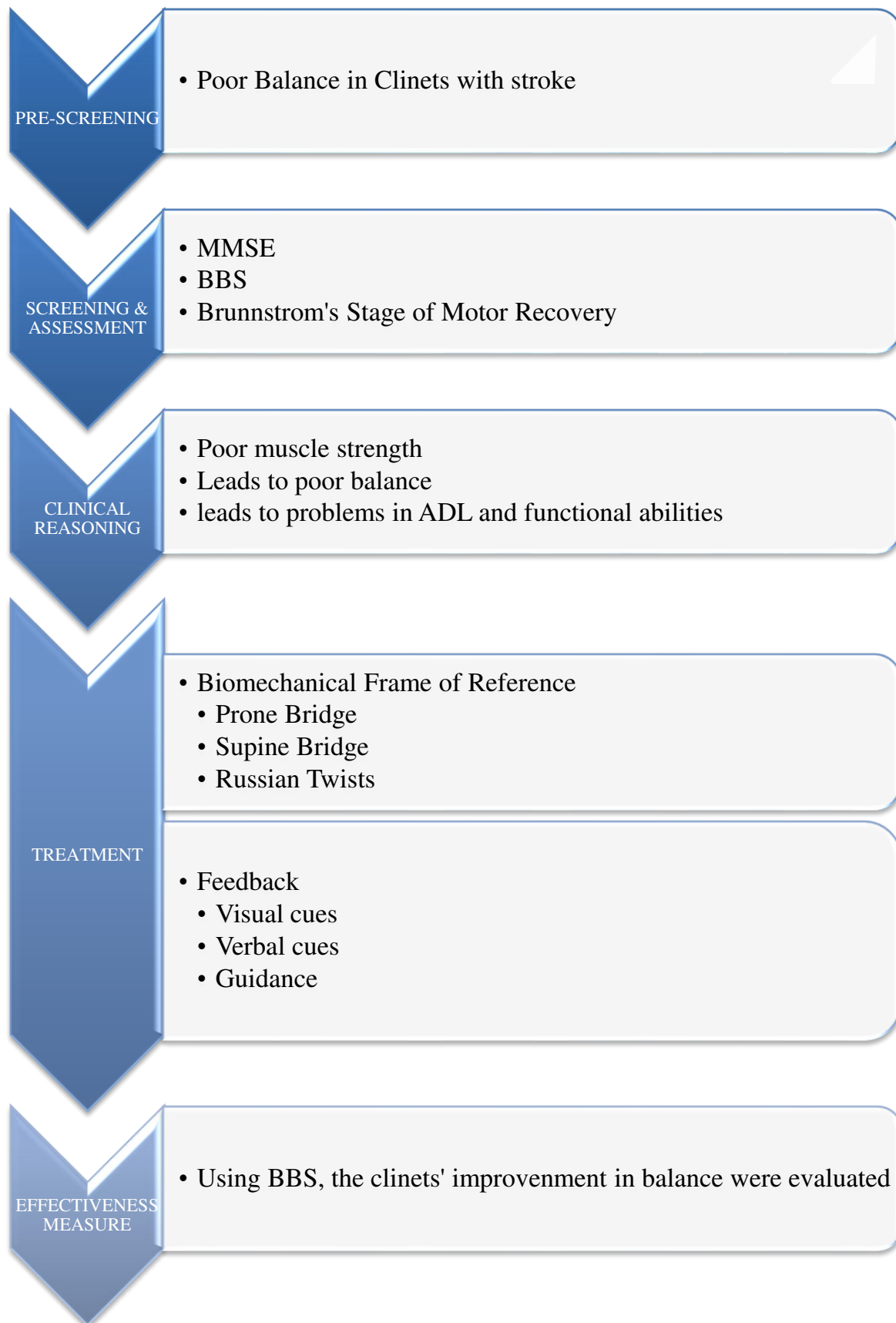
The biomechanical frame of reference techniques are:

- *Prone Bridge*
- *Supine Bridge*
- *Russian Twists*

The feedback techniques that can be used are:

- Visual cues
- Verbal cues / Prompting
- Guiding

## CONCEPTUAL CHART



**Fig: 4. Conceptual Framework based on Biomechanical Frame of Reference and Behavioural Frame of Reference**

## **METHODOLOGY**

### **RESEARCH DESIGN**

The research design that was used was a single group pre-post experimental study design.

### **VARIABLES**

The independent variable in this study was strengthening activities and the dependent variable was balance.

### **SAMPLING TECHNIQUE**

The samples were taken for study by Non-Probability, purposive sampling method. The client who came to department with MCA or PCS involvement during the first 15 days post stroke, were taken for the preliminary screening. They were put through testing in Berg balance Scale, and Mini-Mental State Examination (MMSE), and their Brunnstrom's stage of Motor recovery was noted. If they fitted in the criteria, they were taken for the treatment phase.

### **SETTING & DURATION OF STUDY**

The study was conducted in Kovai Medical Centre and Hospital, Coimbatore, Tamilnadu, India, from April 2010 to December 2010.

### **CRITERIA**

#### ***Inclusion:***

- Clients with cerebro – vascular accident – MCA / PCS
- Clients with balance score of less than 40 in BERG balance scale
- Client with MMSE score of > 20

#### ***Exclusion:***

- Clients with visual problems

- Clients with psychiatric co-morbidity
- Clients with any orthopaedic problems
- Clients with previous history of any other neurological conditions

## TOOLS

### *Screening tools*

- Berg balance Scale,
- The Mini-Mental State Examination (MMSE), and
- Brunnstrom's stages

### Outcome measure

- Berg balance Scale.

### ***Berg Balance Scale***

The Berg Balance Scale (BBS) was developed to measure balance among older people with impairment in balance function by assessing the performance of functional tasks. It is a valid instrument used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in clinical practice and research. The BBS has been evaluated in several reliability studies. It is a 14-item scale designed to measure balance of the older adult in a clinical setting, which will take about 15-20 minutes to complete. It is a five-point scale, ranging from 0-4. "0" indicates the lowest level of function and "4" the highest level of function. Total Score = 56

### *Interpretation:*

41-56 = low fall risk    21-40 = medium fall risk    0-20 = high fall risk

### *Reliability*

Internal consistency: Cronbach's alpha for the total score was 0.96. Individual items ranged from 0.72 to 0.90. Correlations ranged from 0.38 to 0.94.

Intra-rater Reliability: The intra-class correlation (ICC) for the total score was 0.99, ranging from 0.71 to 0.99 for the individual items. 2,3

Inter-rater Reliability: The ICC for the total score was excellent (0.99), and was good to excellent for the individual items (0.71-0.99). 2,3

### *Validity*

Content: Correlations between the Berg scale and the Barthel were 0.80 to 0.94, and 0.62 to 0.94 for the Fugl-Meyer. 2,3

Concurrent: Correlations for sway were -0.55, clinical measures -0.46 to -0.67,

Predictive: A Berg Balance Scale of <45 was predictive of multiple falls.

### ***Folstein test – The Mini Mental Status Examination (MMSE)***

Cognitive deficits are common in stroke patients. Neuropsychological testing is time-consuming and not easy to administer and standardised screening measures are desirable. The Mini-Mental State Examination (MMSE) is most widely applied to screen for cognitive deficits. The MMSE sensitivities over the 3 months of discharge are 0.72, 0.82 and 0.96, respectively. The results indicated that the MMSE has modest qualities in screening and is adequate in screening for moderate cognitive deficits. Poor performance in the MMSE is predictive of cognitive impairment in the long term. Still, it cannot be used to predict further or future cognitive deterioration or improvement over time. (Bour, 2010)

### *Reliability*

Internal consistency: Cronbach's alpha for the total score was 0.96. Individual items ranged from 0.72 to 0.90. Correlations ranged from 0.38 to 0.94.

Intra-rater Reliability: The Intra-rater Reliability of MMSE is 0.82.

Inter-rater Reliability: The Inter-rater Reliability of MMSE is 0.89.

### *Score – Degree of Impairment (Folstein, 1975)*

25 – 30 – Questionably significant deficit

20 – 25 – Mild deficit

10 – 20 – Moderate deficit

0 – 10 – Severe deficit

## **BRUNNSTROM'S STAGES OF MOTOR RECOVERY**

The basic premises of this approach is that, in normal persons, spinal cord and brain stem reflexes become modified during development and their components rearranged into purposeful movement by the influence of higher centres. Since reflexes represent normal stages of development, they can be used when the CNS has reverted to an earlier developmental stage as in hemiplegia. In addition, she believed that no reasonable training method should be left untried. Moreover, the sub-cortical motion synergy, which can be elicited on a reflex basis, may serve as a wedge by which the limited willed movement may be learned.

Brunnstrom classified stages of recovery into six stages:

*Stage 1:* The patient is completely flaccid, no voluntary movement, and patient is confined to bed.

*Stage 2:* Basic limb synergy develops, no voluntary movement, can be done as spasticity appears but is not marked.

*Stage 3:* Basic limb synergy develops voluntarily and is marked, spasticity is marked. (This is the stage of maximal spasticity).

*Stage 4:* Spasticity begins to decrease, four movement combinations deviate from basic limb synergies and become available, which are placing the hand behind the body, alternative pronation – supination with the elbow at 90° flexion and elevation of the arm to a forward horizontal position).

*Stage 5:* There is relative independence of the basic limb synergies. Spasticity is waning, and movements can be performed as arm rising to a side horizontal position, alternative pronation – supination with the elbow extended and bringing hand over the head.

*Stage 6:* There are isolated joint movements.

## **PROCEDURE & DATA COLLECTION**

- Clients with acute stroke were chosen for the study.
- They were screened using Berg balance Scale, Mini Mental Status Examination and Brunnstorm's stages.

- Those who matched the inclusion criteria were taken into the study.
- The clients were provided with the treatment sessions.
- After completion of treatment protocol, they underwent a posttest using Berg Balance Scale.
- The acquired data was analysed.

## **TREATMENT TECHNIQUES:**

### **THE BIOMECHANICAL FRAME OF REFERENCE**

The biomechanical frame of reference was identified as the most frequently used in practice, and rehabilitation frames is among the top five. The biomechanical frame of reference applies the principles of physics to human movement and posture with respect to the forces of gravity. Many health professionals use biomechanical principles in their practice. Occupational therapists are unique in applying them to clients' engagement in the tasks of everyday life. In OT, the principles of movement, including range of motion (ROM), strength, endurance, ergonomics, and the effects or avoidance of pain, must be considered within the context of occupation.

#### ***Strengthening activities:***

##### ***Prone Bridge***

In a face down position, the client should balance on the legs and elbows while attempting to maintain a straight line from heels to head. This exercise focuses on both the anterior and posterior muscle groups of the trunk and pelvis. The grading of the activity is done by the therapist by assisting the client in maintain the body in the straight line, by the help of the pelvis. The amount of assistance can be reduced as the client improves in holding up of the body.

##### ***Supine Bridge***

Lying on your back, with the knees bent, and heel touching your gluteals, raise your hips so that only your head, shoulders, and feet are touching the floor. The grading of the activity is done by the therapist by assisting the client in maintaining the body in the straight line, by lifting of the pelvis. The amount of assistance can be reduced as the client improves in holding up the body.



### *Russian Twists*

Start by sitting on the plinth / bed with hips and knees flexed to approximately 90-degree angles. Swing to the right and left as you keep the hips from rotating with the shoulders. The arms are not perpendicular to the torso, but instead, kept low, near the thighs. The grading of the activity is done by the therapist by assisting the client in maintain the body in the sitting posture and by rotation of trunks. Assistance is given at the shoulder. The amount of assistance can be reduced as the client improves in holding up of the body. More resistance can be given when the client improves by making the client hold a medicine ball in hand.

### FEEDBACK TECHNIQUE

Feedback is Intrinsic or extrinsic information that patients receive while learning to perform a new skill or strategy.

#### ***Therapeutic use of feedback***

Feedback can also enhance or interfere with learning. Occupational Therapists understand the functions of feedback and deliberately select the types and schedules of feedback in designing the patients' learning experience.

#### ***Functions of feedback***

Feedback regarding performance has several functions. It has a temporary motivating or energising effect and a guidance defect that informs the subject how to correct an error on the next trial. However, feedback can permanently impair motor learning if provided beyond the point that the person has a rough idea of the desired motion.

#### ***Types of feedback***

To help patients learn and sustain skills and strategies, therapists initially provide extrinsic feedback on performance but ultimately facilitate the development of intrinsic feedback.

1. Extrinsic feedback: Knowledge of results and knowledge of performance

Therapists typically provide feedback about performance in verbal format. Extrinsic or external information presented after task is complete is called knowledge of results. This feedback allows subject to alter or alert their responses or behaviours on subsequent trials. A second type of feedback, knowledge of performance is related to qualitative description of a performance. This info directs patients' attention not to outcome but to components of movement that they need to change or attend. This type of feedback duplicates information patients already have available through intrinsic feedback; but on which they may not be focusing.

Other external information provided to patients during practice falls into the category of encouragement. It is important that patient and therapist not confuse encouragement with feedback especially if the later is not true, as incorrect feedback is highly detrimental to learning.

## 2. Intrinsic feedback

IF or internal feedback is information that patients receive through their own senses. While this information is readily available to patients, they may need cuing to focus on the most important components of a skill or strategy, such as learning to use vision when moving an anaesthetic limb. Intervention that incorporates self-monitoring and self-estimation (task difficulty, completion time, accuracy score, amount of cuing or assistance needed) enables patients to create mechanisms for self-generated feedback, lessening dependence on therapists for successful performance.

### ***Feedback schedules***

The frequency and content of feedback are critical to the learning process and must be considered when the teaching situation is planned.

## 1. Immediate and summary feedback

The frequency and rate at which the feedback is given can profoundly influence the acquisition and retention of task specific skills and strategies. Immediate feedback provided after each trial was completed or also referred to as constant feedback. Summary feedback provided after a number of trials are completed. In a study done by Lavery (1962), they found out that in acquisition phase both immediate and summary feedback given tighter helped well

than summary feedback alone. However, when tested on retention summary feedback alone helped well.

## 2. Faded feedback

Therapists are often concerned about providing only summary feedback after a series of trials will not understand the tasks that are complex or new. Winstein and Schmidt (1990) evaluated the effectiveness of fading of the feedback. They found a slight advantage for the group with summary feedback in the acquisition phase, but there were significant difference during the retention phase, which is the true test of learning. The group that received faded feedback performed significantly better than immediate feedback on the retention trials. These findings point out the irony that factors that degrade performance during acquisition may improve learning.

## 3. Bandwidth feedback

With Bandwidth feedback, an acceptable range of performance is defined and the subject receives feedback only when performance is outside the range. As the subject's performance improves, feedback is provided less frequently.

*Techniques used for feedback:*

- Visual cues markers kept in front of the client to aid in finding if he is doing it correctly
- Verbal cues / Prompting – giving clues to client stating that he is doing it wrong.
- Guiding - The goal of guiding is input rather than output, it used as a way to document: heavy, moderate, light, or no guidance, influence the Tactile Kinaesthetic sense through non-verbal application

*Things to remember when practicing are:*

- Reinforce the desired behaviour rather than criticise the undesired.
- Immediacy matters: feedback after the event is useful at cognitive level. From a behavioural point of view, the feedback has to be so close to the specific bit of behaviour that there is no doubt, as to what it applies.

## RESULTS AND DATA ANALYSIS

The collected data regarding the problems and interventions executes on clients with stroke were organised, analysed and interpreted as follows.

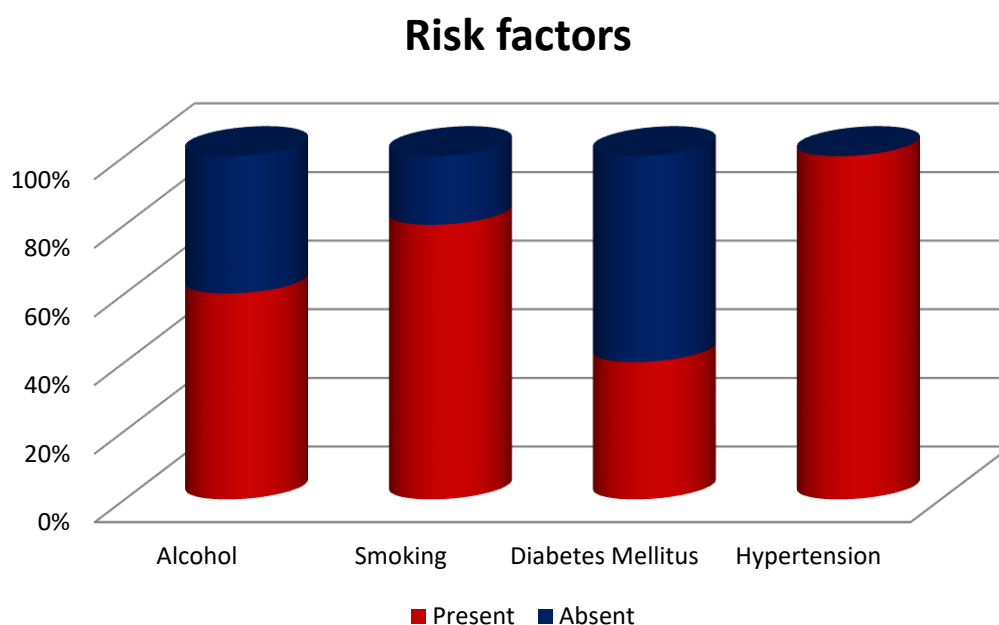
1. Demographic data of the problems
2. Balance problems in the clients
3. Treatment intervention given for the samples
4. Identifying the effectiveness of the treatment provided
5. Detailed description of the components and their improvements

**TABLE: I. SAMPLES CHARACTERISTICS**

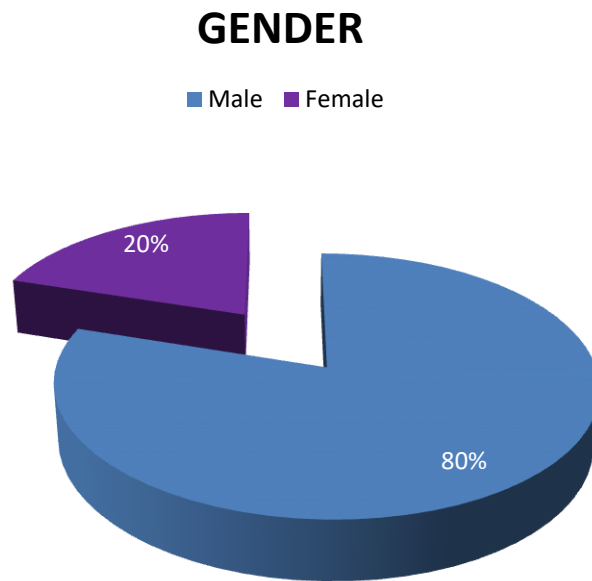
S.No.	Demographic data		Frequency (n = 5)	Percentage (%)
1	<i>Age (in years)</i>			
		50 – 60	1	20
		60 – 70	3	60
		70 – 80	1	20
2	<i>Sex</i>			
		Male	4	80
		Female	1	20
3	<i>Side affected</i>			
		Right	4	80
		Left	1	20
4	<i>Area of infarct</i>			
		Middle Cerebral Artery	5	100
5	<i>Risk factors</i>			
		Alcohol	3	60
		Smoking	4	80
		Diabetes Mellitus	2	40
		Hypertension	5	100

- Among the five samples majority (60%) of them were in the age group of 60 – 70.
- Regarding the sex of the clients, most (80%) of them were male.
- Based on the site of lesion all the clients in the study (100%) were affected in Middle Cerebral Artery (MCA).
- In aspect of side affected, majority (80%) were right sided hemiplegics.
- Of the five samples, three (60%) consumed alcohol and four (80%) were smokers.
- Based on history of other illness, two (40%) had diabetes Mellitus and all five (100%) were hypertensive.

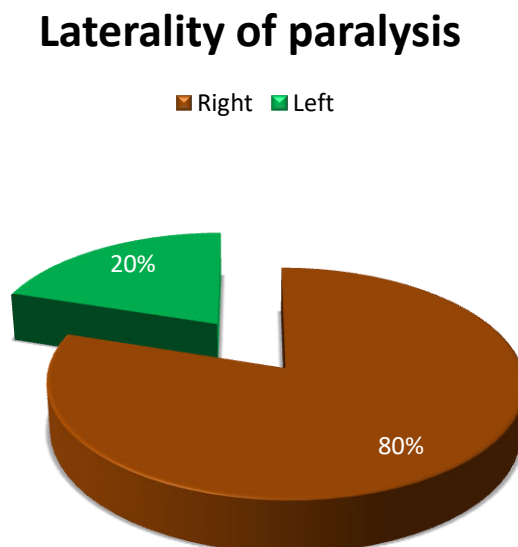
**CHART: IV. DISTRIBUTION OF SAMPLES ACCORDING TO THE  
RISK FACTORS**



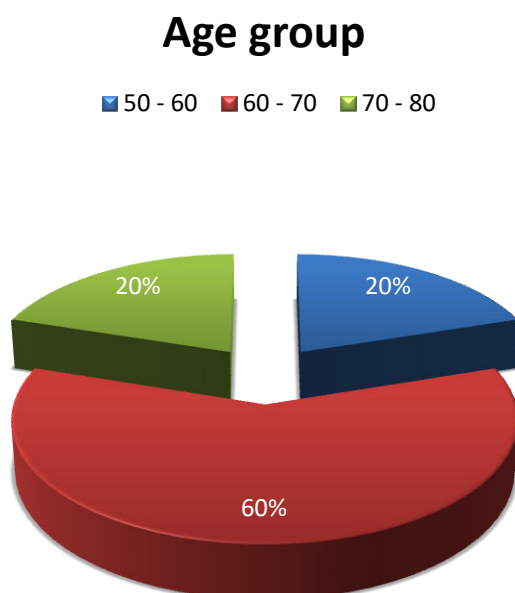
**CHART: I. DISTRIBUTION OF SAMPLES ACCORDING TO GENDER**



**CHART: II. DISTRIBUTION OF SAMPLES ACCORDING TO THE  
LATERALITY OF PARALYSIS**



**CHART: III. DISTRIBUTION OF SAMPLES ACCORDING TO THE  
AGE GROUP**



**TABLE: II. SCREENING TEST SCORES**

Clients	MMSE	Brunnstrom's stage	BBS (Pre-test)
A	22	1	19
B	20	1	20
C	30	1	23
D	23	1	21
E	20	1	16

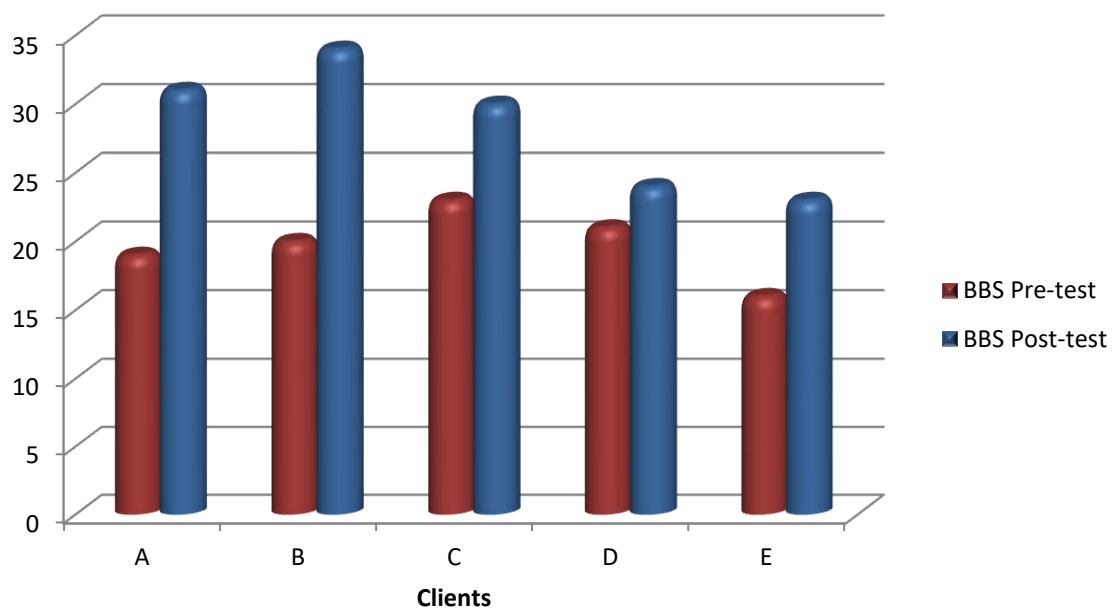
Table II shows the scores of the Mini Mental Status Examination (MMSE), Brunnstrom's stage and pre-test score Berg Balance Scale (BBS), which were used for screening and inclusion purpose.

**TABLE: III COMPARISON OF PRE-TEST vs. POST-TEST OF BERG BALANCE  
SCORE**

Client	A	B	C	D	E
<b>BBS Pre-test</b>	19	20	23	21	16
<b>BBS Post-test</b>	31	34	30	24	23
<b>Score change</b>	12	14	7	3	7
<b>% increase</b>	21.4	25.0	12.5	5.4	12.5

Table: II Shows the comparison of the pre-test scores against post-test values of individual clients. Client A has an increase of 12 in the Berg Balance Scale, which is at 21.4% increase. Client B has an increase of 14, which is 25%. Client C and E had an increase of 12.5%, which is increase in score of 7. Client D showed a increase in score of 3, at 5.4%.

**GRAPH: I COMPARISON OF PRE-TEST vs. POSTTEST OF BERG BALANCE  
GRADE**

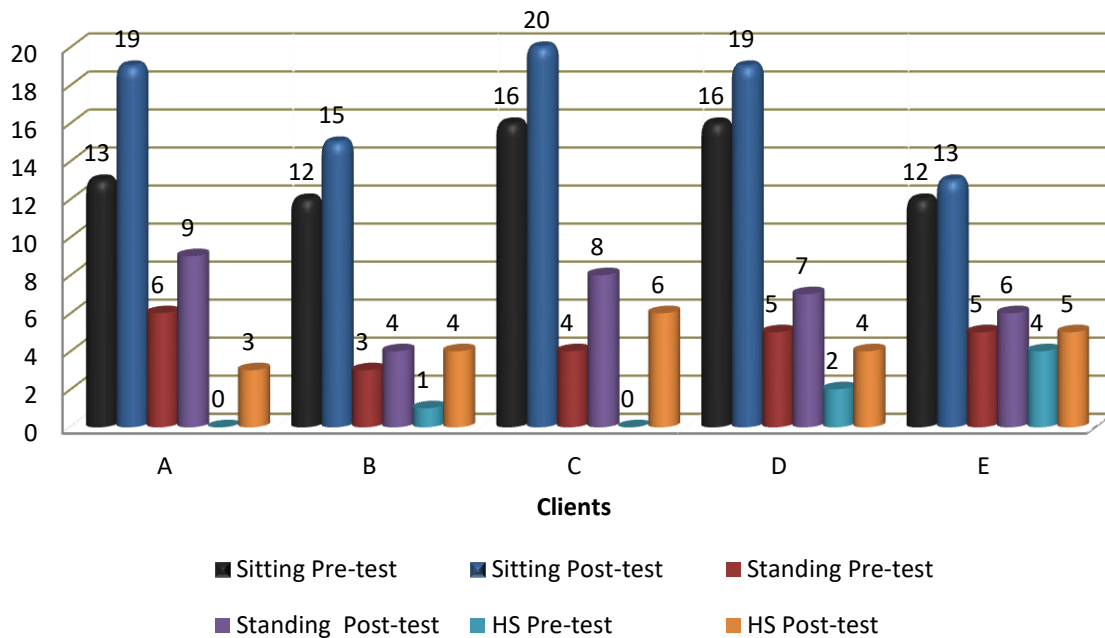




**TABLE: IV. COMPARISON OF PRE-TEST AND POST-TEST VALUES OF COMPONENTS OF BERG BALANCE SCALE (SITTING, STANDING AND HIGHER SKILLS)**

Client	Sitting total			Standing total			Higher skill total			Total change
	Pre-test	Post-test	Change	Pre-test	Post-test	Change	Pre-test	Post-test	Change	
<b>A</b>	13	19	6	6	9	3	0	3	3	12
<b>B</b>	16	20	4	4	8	4	0	6	6	14
<b>C</b>	16	19	3	5	7	2	2	4	2	7
<b>D</b>	12	13	1	5	6	1	4	5	1	3
<b>E</b>	12	15	3	3	4	1	1	4	3	7

**GRAPH: II. COMPARISON OF MEAN VALUES OF PRE-TEST AND POST TEST OF COMPONENTS OF BERG BALANCE SCALE (SITTING, STANDING AND HIGHER SKILLS)**



## **DISCUSSION**

Stroke, among all the neurologic diseases, clearly ranks first in frequency and importance. It is characterized by a sudden or gradual onset of neurological deficits. Loss of trunk control is commonly observed in patients who have had a stroke. Impairment in trunk control may lead to the dysfunction in upper and lower limb control, increased risk of falls, potential for spinal deformity and contracture, impaired ability to interact with the environment, visual dysfunction secondary to resultant head/neck mal-alignment, symptoms of dysphagia secondary to proximal mal-alignment, and decreased independence in activities of daily living. Balance is the ability to control the centre of mass over the base of support within the limits of stability; balance results in the maintenance of stability and equilibrium. A person's ability to maintain balance in any position depends on a complex integration of multiple systems.

Ryerson (2008) did a study to determine whether trunk position sense is impaired in people with post-stroke hemiparesis. Twenty subjects with chronic stroke and 21 non-neurologically impaired subjects participated in the study. Trunk repositioning error during sitting forward flexion movements was assessed. Subjects with poststroke hemiparesis exhibit greater trunk repositioning error than age-matched controls. Trunk position sense retraining, emphasizing sagittal and transverse movements, should be further investigated as a potential post-stroke intervention strategy to improve trunk balance and control

Oliveira (2008) stated that balance problems in hemiparetic patients after stroke can be caused by different impairments in the physiological systems involved in postural control, including sensory afferents, movement strategies, biomechanical constraints, cognitive processing, and perception of verticality and balance impairments and disabilities must be appropriately addressed. It was also stated in the article that they reviewed the most common balance abnormalities in hemiparetic patients with stroke and the main tools used to diagnose them. In the result of the study, they came up with many scales for the use of therapist in balance assessment and training. They were Berg Balance Scale (BBS), Timed Get Up & Go Test (TUG), Tinetti Balance Test (TBT), Functional Reach Test (FR), Balance Subscale of Fugl - Meyer Test (FM-B), Postural Assessment Scale for Stroke Patients (PASS), Dynamic Gait Index (DGI), Multi-Directional Reach Test (MDRT), and Activities-Specific Balance Confidence (ABC) Scale. In conclusion, they stated that the balance is a complex motor skill that depends on interactions between multiple sensori-motor processes, and environmental,

and functional contexts. In addition, Stroke can affect different functions independently, or in combination, causing heterogeneous neurological impairments and compensatory strategies. Because of such diversity, the individualized rehabilitation is likely to be benefited from precise assessment of each patient's impairments in motor, sensory, and cognitive aspects of postural control, as well as its functional implications. Different tools for balance assessment have to be validated and should be chosen according to individual characteristics of clients with stroke. Even though laboratory measurements are not widely available, they can provide precise information and should be combined with the clinical evaluation whenever possible to enhance comprehension of the postural impairments and disabilities in hemiparetic clients.

The current study is an evaluatory descriptive method of investigation designed to identify the effect of Biomechanical coupled with Behavioural techniques on balance for clients with stroke. The sample in this study consisted of five clients. The general outline of the clients and the brief data is given in the table 1.

#### **The first objective was to evaluate the presence of problems in balance in clients with stroke**

The functional and self-care independency in clients with stroke depends mainly on the sitting and the standing balance (Sandin, 1990).

The sample (Table I) taken for the study showed the following characteristics. Among the five samples majority (60%) of them were in the age group of 60 – 70. Regarding the sex of the clients, most (80%) of them were males. Based on the site of lesion all the clients in the study (100%) had Middle Cerebral Artery (MCA) involvement. In aspect of side affected, majority (80%) were right sided hemiplegics. Of the five samples, three (60%) consumed alcohol and four (80%) were smokers. Based on history of other illness, two (40%) had diabetes Mellitus and all five (100%) were hypertensive.

For screening (Table II) of the clients for this study, the clients underwent an evaluation of Cognition and Postural Assessments. For this study Mini Mental Status Examination (MMSE), Brunnstrom's Stage and Berg Balance Scale (BBS) were used.

The initial score of BBS of all 5 clients was between 16 and 23 which shows that they were either in the low risk for fall category or medium risk for fall category.

Based on MMSE, 4 clients scores ranged between 20 and 23 which shows that they had mild cognitive impairment (Folstein 1975) and only client C had a score of 30 which shows that his cognitive impairment was questionably significant.

All five clients were in the flaccid stage according to Brunnstrom's stages of motor recovery (stage 1) (Pedretti).

**The second objective of the study was to implement the interventions to the clients with stroke.**

For the intervention, activities were provided based on the Biomechanical frame of reference with the aid of feedback techniques.

## THE BIOMECHANICAL FRAME OF REFERENCE

The Biomechanical Frame of Reference was identified as the most frequently used in practice, and is among the top five. The Biomechanical Frame of Reference applies the principles of physics to human movement and posture with respect to the forces of gravity. Many health professionals use biomechanical principles in their practice. Occupational therapists are unique in applying them to clients' engagement in the tasks of everyday life. In OT, the principles of movement, including range of motion (ROM), strength, endurance, ergonomics, and the effects or avoidance of pain, must be considered within the context of occupation. The technique used under Biomechanical frame of Reference is strengthening.

*Techniques used under Biomechanical Frame of Reference:*

- Prone Bridge
- Supine Bridge
- Russian Twists

## FEEDBACK TECHNIQUE

Feedback is Intrinsic or extrinsic information that patients receive while learning to perform a new skill or strategy.

### ***Therapeutic use of feedback***

Feedback can also enhance or interfere with learning. Occupational Therapists understand the functions of feedback and deliberately select the types and schedules of feedback in designing the patients' learning experience.

### ***Functions of feedback***

Feedback regarding performance has several functions. It has a temporary motivating or energising effect and a guidance defect that informs the subject how to correct an error on the next trial. However, feedback can permanently impair motor learning if provided beyond the point that the person has a rough idea of the desired motion.

### ***Types of feedback***

To help patients learn and sustain skills and strategies, therapists initially provide extrinsic feedback on performance but ultimately facilitate the development of intrinsic feedback.

#### **1. Extrinsic feedback: Knowledge of results and knowledge of performance**

Therapists typically provide feedback about performance in verbal format. Extrinsic or external information presented after task is complete is called knowledge of results. This feedback allows subject to alter or alert their responses or behaviours on subsequent trials. A second type of feedback, knowledge of performance is related to qualitative description of a performance. This info directs patients' attention not to outcome but to components of movement that they need to change or attend. This type of feedback duplicates information patients already have available through intrinsic feedback; but on which they may not be focusing.

Other external information provided to patients during practice falls into the category of encouragement. It is important that patient and therapist not confuse encouragement with feedback especially if the later is not true, as incorrect feedback is highly detrimental to learning.

#### **2. Intrinsic feedback**

IF or internal feedback is information that patients receive through their own senses. While this information is readily available to patients, they may need cuing to focus on the

most important components of a skill or strategy, such as learning to use vision when moving an anaesthetic limb. Intervention that incorporates self-monitoring and self-estimation (task difficulty, completion time, accuracy score, amount of cuing or assistance needed) enables patients to create mechanisms for self-generated feedback, lessening dependence on therapists for successful performance.

### ***Feedback schedules***

The frequency and content of feedback are critical to the learning process and must be considered when the teaching situation is planned.

#### **1. Immediate and summary feedback**

The frequency and rate at which the feedback is given can profoundly influence the acquisition and retention of task specific skills and strategies. Immediate feedback provided after each trial was completed or also referred to as constant feedback. Summary feedback provided after a number of trials are completed. In a study done by Lavery (1962), they found out that in acquisition phase both immediate and summary feedback given together helped well than summary feedback alone. However, when tested on retention summary feedback alone helped well.

#### **2. Faded feedback**

Therapists are often concerned about providing only summary feedback after a series of trials will not understand the tasks that are complex or new. Winstein and Schmidt (1990) evaluated the effectiveness of fading of the feedback. They found a slight advantage for the group with summary feedback in the acquisition phase, but there were significant difference during the retention phase, which is the true test of learning. The group that received faded feedback performed significantly better than immediate feedback on the retention trials. These findings point out the irony that factors that degrade performance during acquisition may improve learning.

#### **3. Bandwidth feedback**

With Bandwidth feedback, an acceptable range of performance is defined and the subject receives feedback only when performance is outside the range. As the subject's performance improves, feedback is provided less frequently.

*Techniques used for feedback:*

- Visual cues markers kept in front of the client to aid in finding if he is doing it correctly
- Verbal cues / Prompting – giving clues to client stating that he is doing it wrong.
- Guiding - The goal of guiding is input rather than output, it used as a way to document: heavy, moderate, light, or no guidance, influence the Tactile Kinaesthetic sense through non-verbal application

*Things to remember when practicing are:*

- Reinforce the desired behaviour rather than criticise the undesired.
- Immediacy matters: feedback after the event is useful at cognitive level. From a behavioural point of view, the feedback has to be so close to the specific bit of behaviour that there is no doubt, as to what it applies to.

**The third objective of the study was to evaluate the interventions executed to the clients with stroke.**

The outcome measure that was used for the treatment given during the study was Berg Balance Scale. Berg Balance Scale was administered on the clients before and after the intervention.

With regards to Berg Balance Scale (Table III), all the clients shifted from a high fall risk to medium fall risk level. Client A has an increase of 12 in the Berg Balance Scale, which is at 21.4% increase. Client B has an increase of 14, which is 25%. Client C and E had an increase of 12.5%, which is increase in score of 7. Client D showed a increase in score of 3, at 5.4%.

In the pre-test in BBS (Table III), the client E (16) showed the least score and client C (23) showed the highest. However, after the treatment was completed the post-test score of client C became the second highest, with client B (34) having the highest score and client E (23) still having the lowest score of the five.

The individual components of BBS, sitting, standing and higher balance skills were considered. The balance scores were taken and compared in Table IV. Client B had the

highest change in the group with a score difference of 4 in the component of sitting, difference of 4 in component of standing, and difference of 6 in higher balance skills. Client A had a score difference of 6 in the component of sitting, difference of 3 in component of standing, and difference of 3 in higher balance skills. Client C had a score difference of 3 in the component of sitting, difference of 2 in component of standing, and difference of 2 in higher balance skills. Client E had a score difference of 3 in the component of sitting, difference of 1 in component of standing, and difference of 3 in higher balance skills. Client D had the lowest score with an increase of 1 in all the 3 components.

In this study, the client B showed the maximum improvement of 14 (25%) compared to client D who got a difference of only 3 which is 5.4%. Client B showed considerable increase in the treatment setting, this might be due to motivation and family support. Client D also showed a minimal difference on BBS post-test due to decreased self-esteem, self-confidence and reduced compliance to therapy schedules.

Client C, even with the highest score in MMSE (30) did not show considerable improvement in balance. This was because the client initially was interested in the program and slowly started losing his motivation.

The clients who were showing higher cognitive functioning had higher balance scores in the pre-test level. Moreover, they were able to work better in clinical setting. There were 2 clients (No B & E) with the score of 20 in MMSE, they were finding it difficult to grasp the concept of the training and required constant guiding and cuing more than the other 3. Client E needed assistance more than client B did in the treatment sessions. This might have been because she was 80 years of age and she started showing signs of age related deterioration.

In BBS (Table IV), in sitting component, the client A scored the highest with 6 and the client E with the lowest with 1. In standing component, the client A had the highest improvement and the lowest improvement by the client E. In higher skills, client B improved by 6, which is twice as much as the highest scored by 2 other clients (Client A & E). And lowest was scored by client E. Client B scored the highest in the total improvement of the clients in BBS; the improvement was over all 3 components was 4, 4, 6 and the client E (1, 1, 1) scored the lowest in the total improvement.

This study shows that there is a change in the balance scores among the clients with stroke when using the strengthening activities. This coincides with the study done by Oliveira



(2008) stating that the biomechanical constraints lead to balance problems in hemiparetic patients after stroke. Activities based on Biomechanical Frame of Reference coupled with the aid of feedback techniques works for improving balance in clients with stroke. Even with limited client numbers and limited time duration of the study, this response was been able to be elicited. This suggests that this can be further dealt with in future researches and can be combined in future treatment protocols to work on clients with stroke.

## LIMITATIONS AND RECOMMENDATIONS

This study was started in order to evaluate the effectiveness of early treatment of balance, in stroke clients, using Biomechanical frame of reference with the aid of feedback techniques and come up with a strong conclusion. In the process of study, there had been few hurdles. Of which, few have been surpassed, but still few have not been able to.

The number of clienteles that was initially desired, by the researcher, was not available during the course of study. Many of the clienteles available were not fulfilling the inclusion criteria, thus requiring the researcher to limit the number to the available. However, due to the high percentage of improvement in few of the clients, the researcher suggests that a study can be carried out to one a larger scale of population for further identifying the effectiveness.

Due to the limited time frame available for the conduction of the study, the researcher was pressed upon with limited number of therapy sessions and limited number of hours on each session. Owing to this factor, testing of the transference of training on to the real world experience was not feasible. This inhibited the real and actual effectiveness of the treatment and training that was given to the client. In order to eliminate this problem, the further research that would be done for the same, would be given priority on the long-term effect and not only the therapeutic effect of the therapy session. This not only improves the usefulness and efficacy of the treatment offered but also to the future generations that use these techniques for improvement of the clients. The researcher states that the time for working with client should be more than 4 – 6 months, to precisely identify the improvement because of the training, apart from the natural recovery.

As stated previously, because there was time constraint, there was not enough focus on the other aspects of balance like visual misperceptions. In future researches, this should be taken into consideration, to avoid any complicating issues.

One of the key features that were noted in many literatures is the natural course of the disease (Willard & Spackman). The maximum amount of improvement is in the first 3 months of the disease. This has to be taken into consideration as often as possible when setting goals. If not, the treatment either would most probably be, at the best, not working or, worse, would be hindering the natural course.

## **CONCLUSION**

Balance training is a part of stroke rehabilitation. How much ever we train clients in other activities, research shows that early balance leads to better recovery and faster improvement in functional activities and activities of daily living.

The results of this study showed that early strengthening activities coupled with feedback techniques assists in improving balance in clients with stroke.

Even with the limitations noted in the study, the results show that there is an adequate increase in the balance score after therapy.

It is therefore recommended, that further research could be carried in view of perceptual assessment and intervention and its effects on balance training in clients with stroke.

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## APPENDIX: 1 - CHART FOR LIST OF CLIENTS

S.No.		1	2	3	4	5	
Name		Arumugam	Varadharajan	Dhanakotti	Abdul Jabbar	Nallamal	
Age		59	62	65	70	80	
Sex		M	M	M	M	F	
Dx	Side	R	R	L	R	R	
	Specs.	MCA	MCA	MCA	ICH/MCA	MCA	
Risk factors	Alcohol	Yes	Yes	-	Yes	-	
	DM	-	-	-	Yes	Yes	
	HTN	Yes	Yes	Yes	Yes	Yes	
	Smokin	Yes	Yes	Yes	Yes	-	
MMSE	1 (5)	3	5	4	3	3	
	2 (5)	4	5	3	2	3	
	3 (3)	3	3	3	3	2	
	4 (5)	4	5	4	4	2	
	5 (3)	2	3	2	2	3	
	6 (2)	1	2	2	2	2	
	7 (1)	0	1	1	0	1	
	8 (3)	2	3	2	3	2	
	9 (1)	1	1	1	1	1	
	10 (1)	1	1	0	0	0	
	11 (1)	1	1	1	0	1	
	Total 30	22	30	23	20	20	
Berg Balance Scale	Pre score	1 (4)	3	3	3	2	2
		2 (4)	2	3	3	2	2
		3 (4)	3	4	4	3	3
		4 (4)	3	3	3	3	3
		5 (4)	2	3	3	2	2
		6 (4)	2	2	2	1	1
		7 (4)	2	2	1	1	2
		8 (4)	1	0	1	1	1
		9 (4)	1	0	1	0	1
		10 (4)	0	0	2	1	2
		11 (4)	0	0	0	0	2
		12 (4)	0	0	0	0	0
		13 (4)	0	0	0	0	0
		14 (4)	0	0	0	0	0
		Total 56	19	20	23	16	21

CHART FOR LIST OF CLIENTS (Cont.)

<b>S.No.</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Name</b>		<b>Arumugam</b>	<b>Varadharajan</b>	<b>Dhanakotti</b>	<b>Abdul Jabbar</b>	<b>Nallamal</b>
<b>Berg Balance Scale</b>	<b>Post score</b>	1 (4)	4	4	4	2
		2 (4)	4	4	4	3
		3 (4)	4	4	4	3
		4 (4)	4	4	3	3
		5 (4)	3	4	3	2
		6 (4)	4	3	3	1
		7 (4)	3	3	2	1
		8 (4)	1	1	1	1
		9 (4)	1	1	1	1
		10 (4)	2	3	4	3
		11 (4)	1	2	0	1
		12 (4)	0	1	0	0
		13 (4)	0	0	0	0
		14 (4)	0	0	0	0
		Total56	31	34	30	23